Weather Forecasting Application

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Introduction

Weather Forecasting is the scientific process of predicting atmospheric conditions at a specific time and place using current data and meteorological models.

- Weather patterns are highly dynamic and can change quickly, necessitating timely and accurate forecasts.
- Accurate weather forecasts are essential for various sectors, including agriculture, industry, and travel, to ensure safety, efficiency, and productivity.
- Climate change is increasing the frequency of extreme weather events, making accurate forecasting crucial for disaster preparedness and mitigation.
- Forecasting involves collecting data such as temperature, humidity, and wind speed from sources like weather stations and satellites. This data is analyzed with meteorological techniques to predict future weather conditions.

Objective

- Improved Accuracy
- Short-term and Long-term Forecasting
- Real-time Updates
- Severe Weather Alerts
- Customization
- Visualizations
- User-Friendly Interface
- Energy and Resource Optimization
- Research and Development

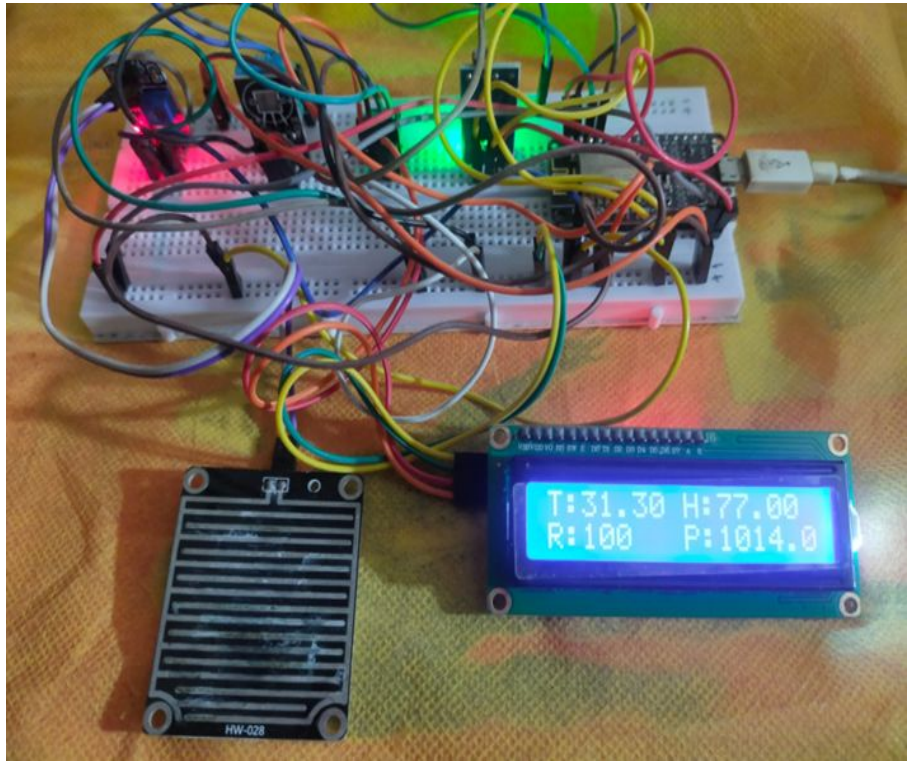
Problem Statement and Motivation

Problem Statement:

- Existing weather apps lack precision for agriculture, impacting crop yield and resource utilization.
- Underutilization of weather stations in educational institutions for agricultural forecasting.
- Complex data presentation in current apps hampers user interpretation and decision-making.

Motivation:

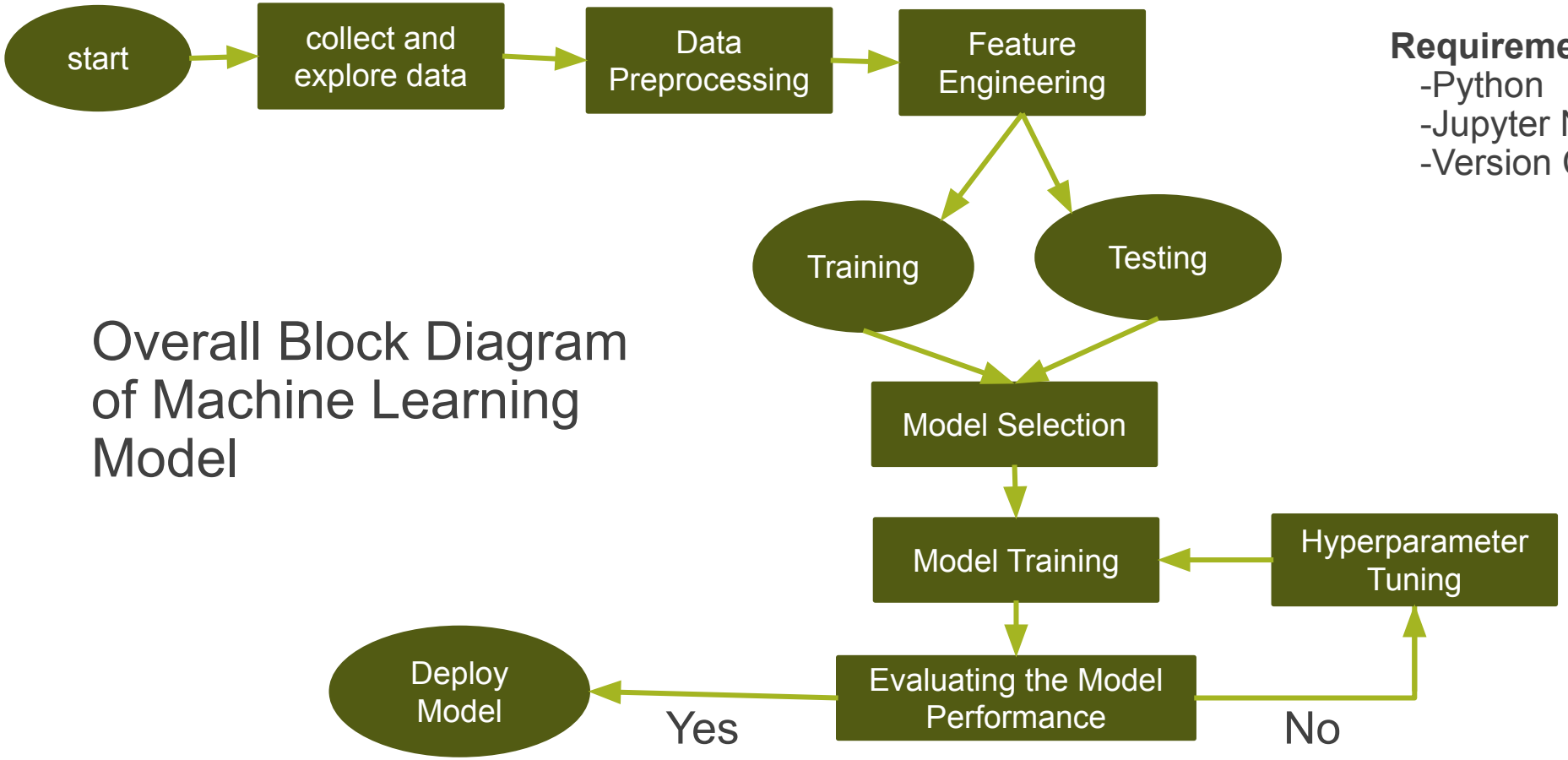
- Our mini project was IoT-based real-time weather monitoring system.
- Installation of a new weather station in our college inspired us to utilize the data for accurate weather forecasting.



Literature Survey

Title of the paper	Methodology	Specifications	Accuracy
[1] Integration of IoT in Weather Data Collection	Discusses the technical aspects of using NodeMCU, addressing issues related to data accuracy and real-time monitoring	Developed using NodeMCU and sensors like temperature and rainfall.	Manual Data Collection upto 78%
[2] Weather Forecasting Using Machine Learning	Approaches include data preprocessing, feature engineering, and model training.	Machine Learning Algorithms used – Linear Regression and Support Vector Machine	85%

Signal Flow Diagram

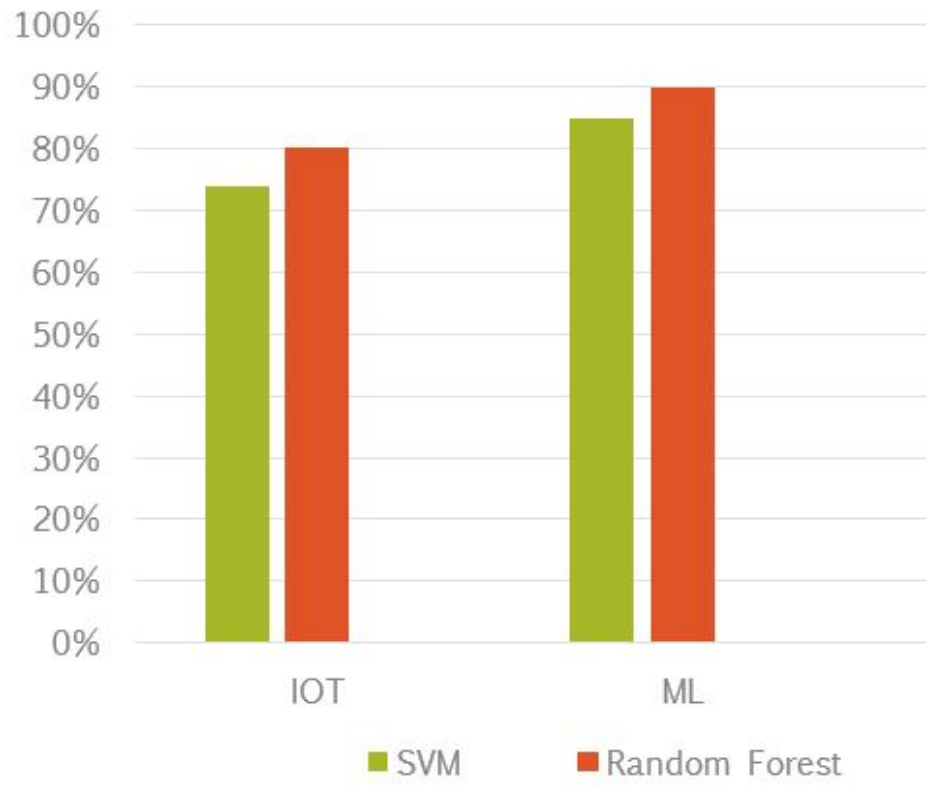


Overall Block Diagram of Machine Learning Model

Requirements:

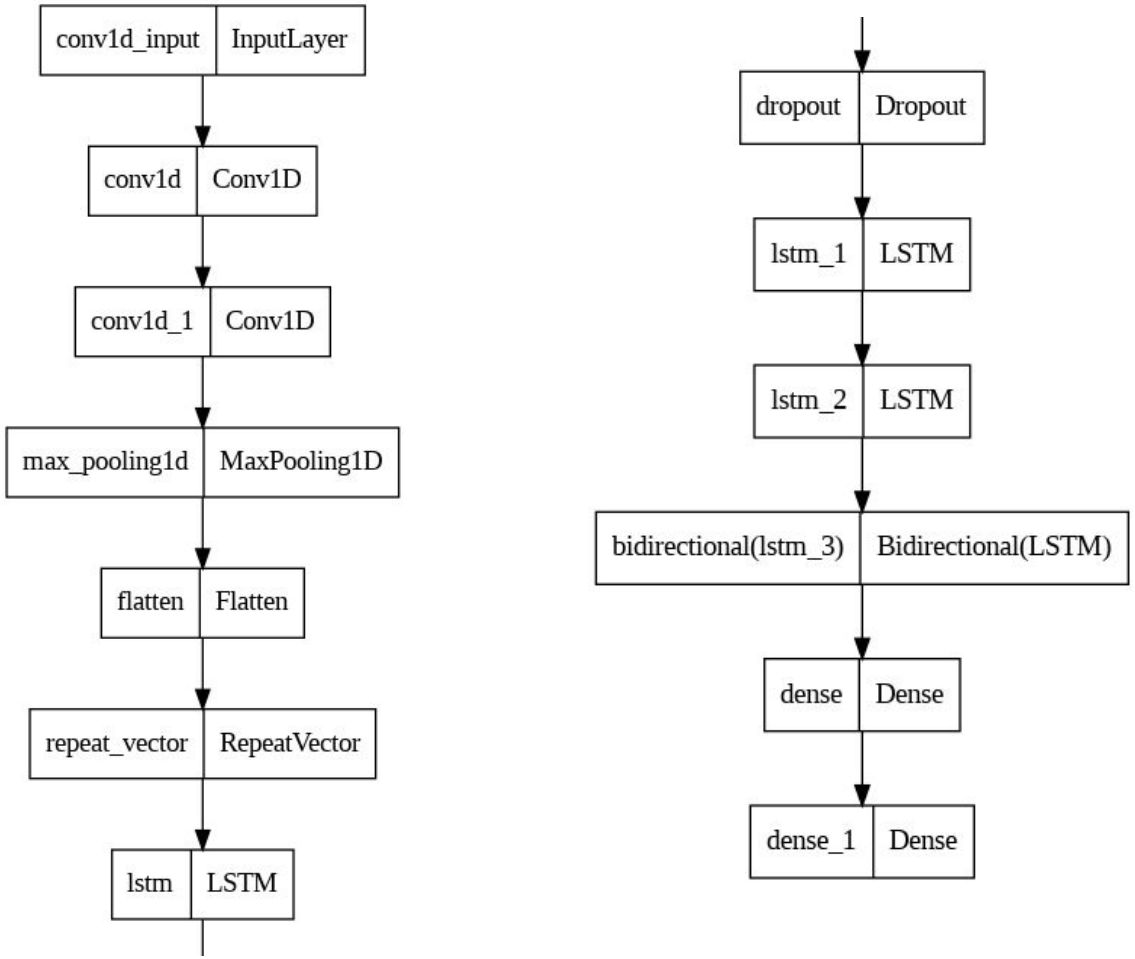
-Python
-Jupyter Notebook/Google Colab
-Version Control (Git/GitHub)

Accuracy Comparison



- The Random Forest model appears to be performing slightly better than the SVM model for your weather forecasting task.
- The lower MSE indicates that the Random Forest model's predictions are more accurate when compared to the true values in your test set.

Proposed ML Model

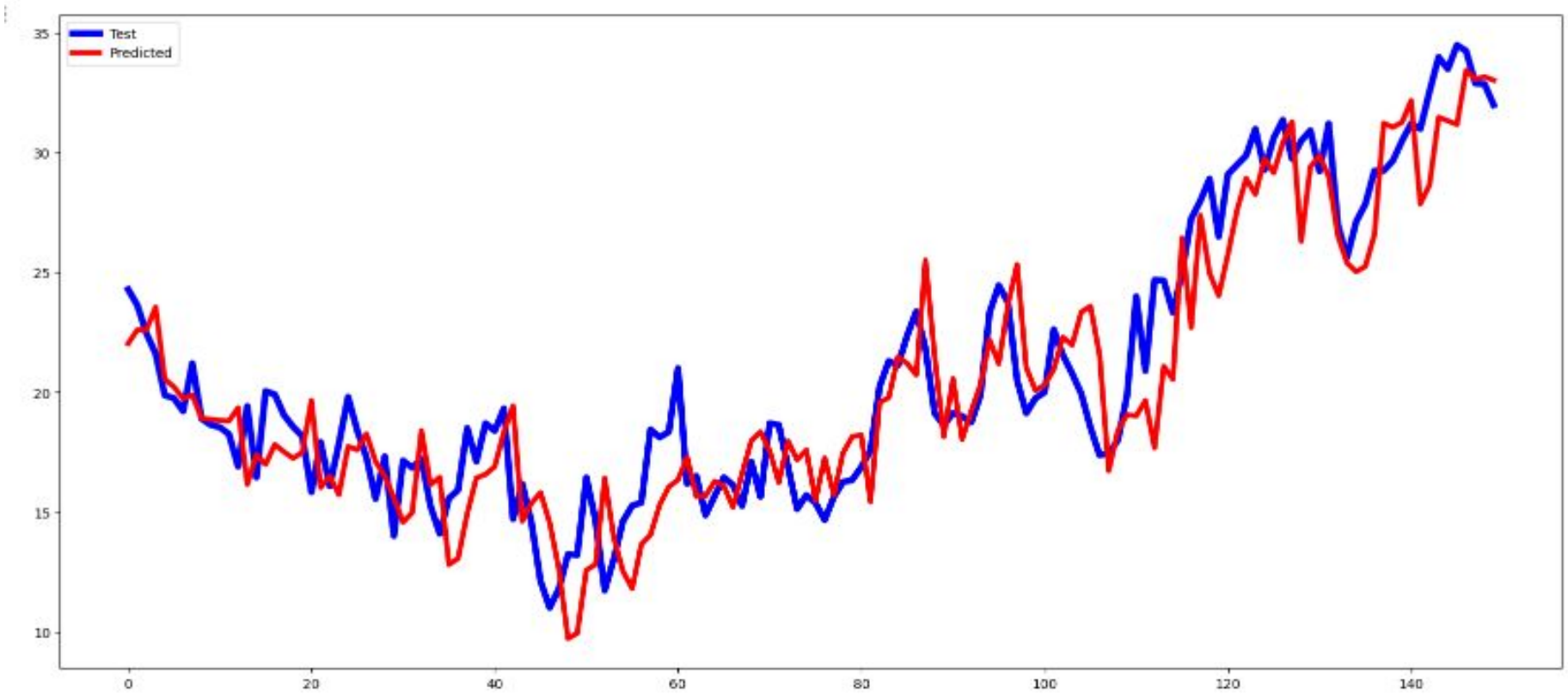


Time series analysis is applied to predict temperature using Recurrent Neural Networks (RNNs), specifically Long Short-Term Memory networks (LSTMs).

Time Series Forecasting

- The model comprises Convolutional and LSTM layers, addressing the long-term dependency problem inherent in time series data.
- LSTMs handle long-term dependencies, while Bidirectional LSTMs capture information from both past and future directions.
- Two Convolutional layers with 2x2 kernel size extract features, and Max Pooling selects relevant values for dimensionality reduction.
- Flattening and repetition of vectors prepare data for LSTM layers, featuring tanh activation and dropout for improved generalization.
- An ANN layer with ReLU activation extracts complex patterns, concluding with an output node for temperature predictions.
- The model is compiled with ADAM optimizer and trained for 300 epochs, balancing efficiency and convergence

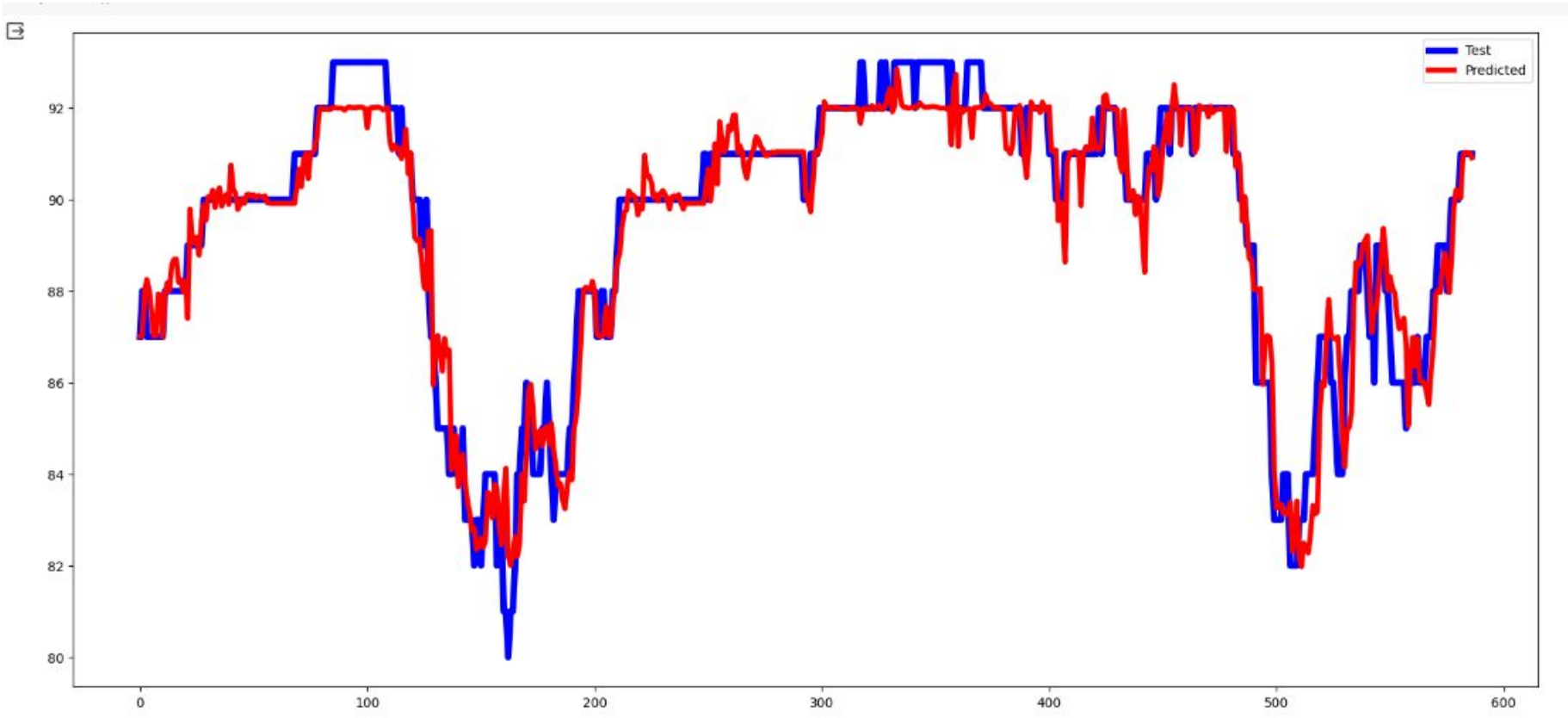
Result Analysis of Temperature



Actual vs Predicted output

The blue plot is the actual plot of data given in the dataset and the red plot is of our predicted values by the model. The error between actual and predicted is very less.

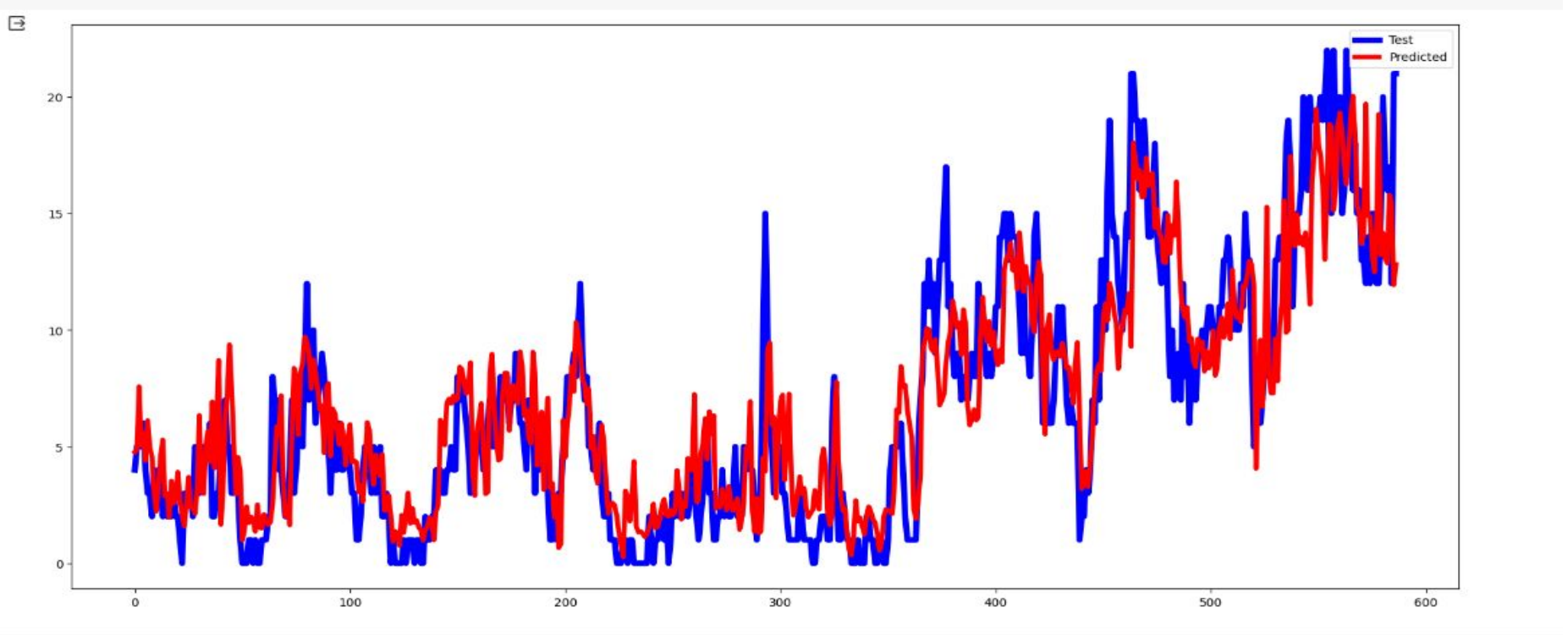
Result Analysis of Humidity



Actual vs Predicted output

The blue plot is the actual plot of data given in the dataset and the red plot is of our predicted values by the model. The error between actual and predicted is very less.

Result Analysis of Windspeed



Actual vs Predicted output

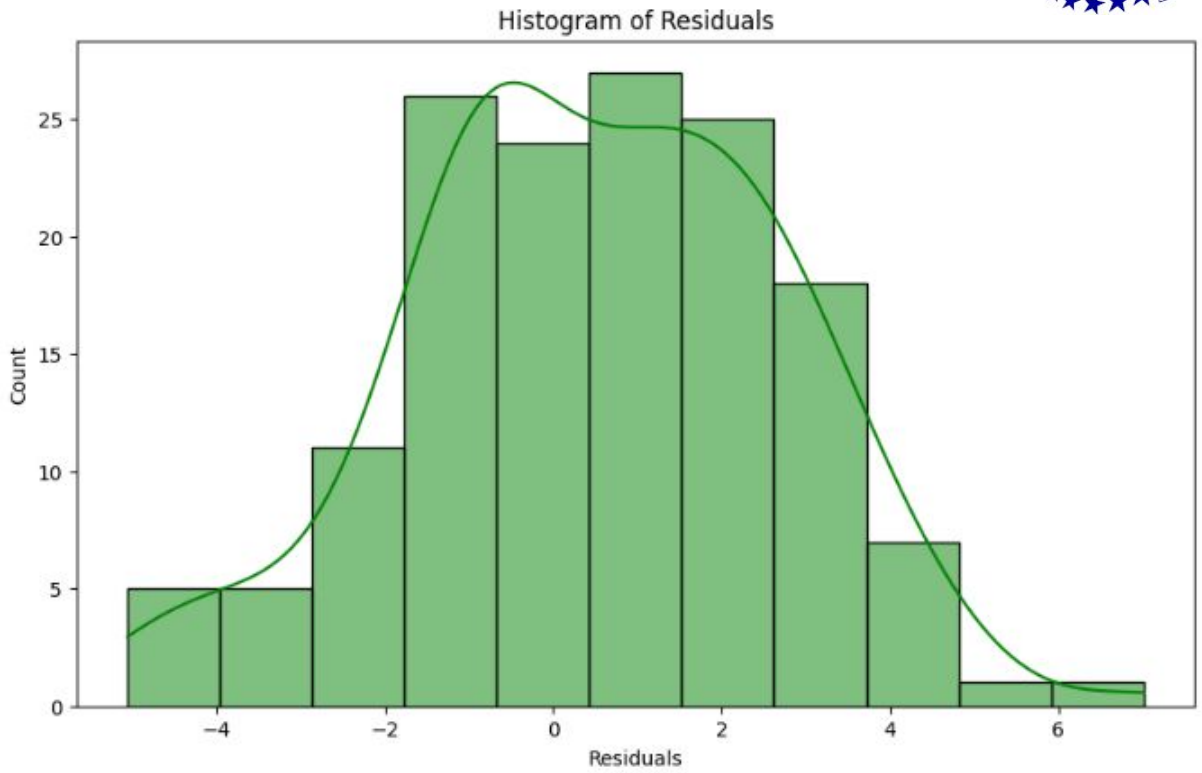
The blue plot is the actual plot of data given in the dataset and the red plot is of our predicted values by the model. The error between actual and predicted is very less.

```
# Mean Absolute Error (MAE)
mae = mean_absolute_error(Ytesting, predict)
print(f'MAE: {mae}')
```

```
MAE: 1.8525111274629429
```

```
[ ] from sklearn.metrics import r2_score
    r2 = r2_score(Ytesting, predict)
    print(f'R-squared: {r2}')
```

```
R-squared: 0.8462354713947638
```

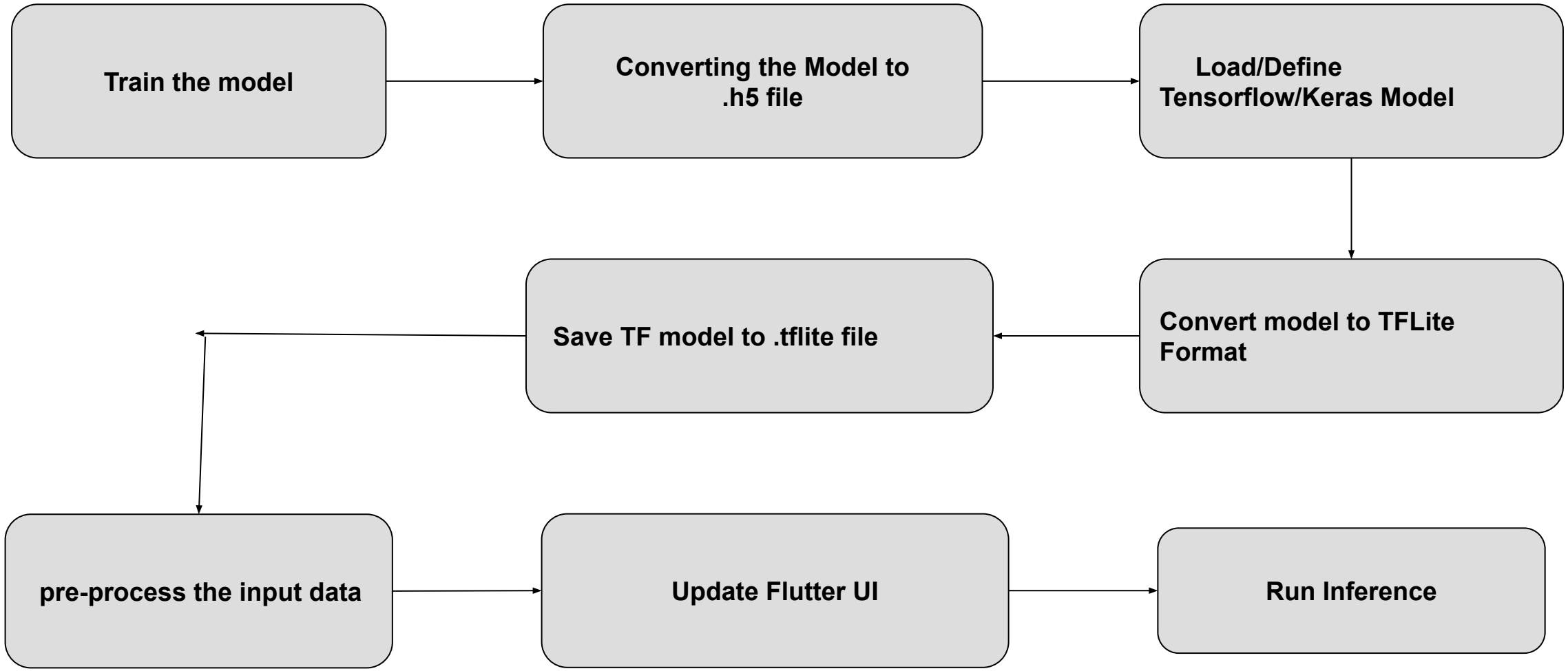


This plot provides a distribution of the residuals

Integration of Machine Learning Model with TFlite:

- TensorFlow Lite (TF Lite) is a lightweight machine learning framework developed by Google that is specifically designed for mobile and embedded devices.
- It is an optimization of TensorFlow, Google's open-source machine learning framework, and it enables the deployment of machine learning models on devices with limited computational resources, such as smartphones, tablets, IoT devices, and microcontrollers.
- It is designed to be easy to use, highly performant, and capable of handling asynchronous operations efficiently.

Flowchart of Integrating TFLite with Flutter :

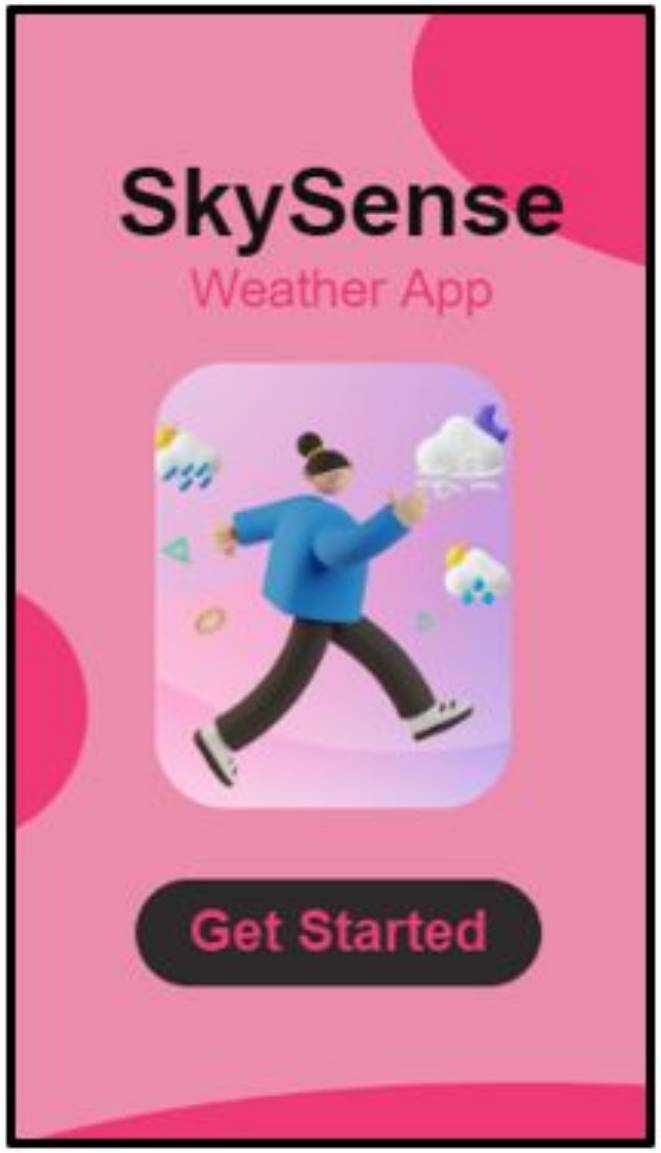


Developing the Flutter App:

- Flutter is an open-source UI software development kit created by Google.
- It uses the Dart programming language and provides a rich set of pre-designed widgets, enabling rapid development of beautiful and performant user interfaces.

Features:

- Single Codebase
- Fast Development
- Native Performance
- Customizable UI


SkySense
Weather App
Get Started


Juhu
12:13 PM
Thursday 23.5.2024
haze
33° C
Max: 33° C
Min: 33° C
Wind: 6m/s
Humidity: 75%


SkySense
Weather App
Get Started


Back
7-Days Weather Forecast:
Thursday
2:30 PM
33° C
Thursday
5:30 PM
33° C
Thursday
8:30 PM
31° C
Thursday
11:30 PM
30° C


7-Days Weather Forecast:
Friday
2:30 AM
29° C
Friday
5:30 AM
29° C
Friday
8:30 AM
30° C
Friday
11:30 AM
32° C


Back
7-Days Weather Forecast:
Friday
2:30 PM
33° C
Friday
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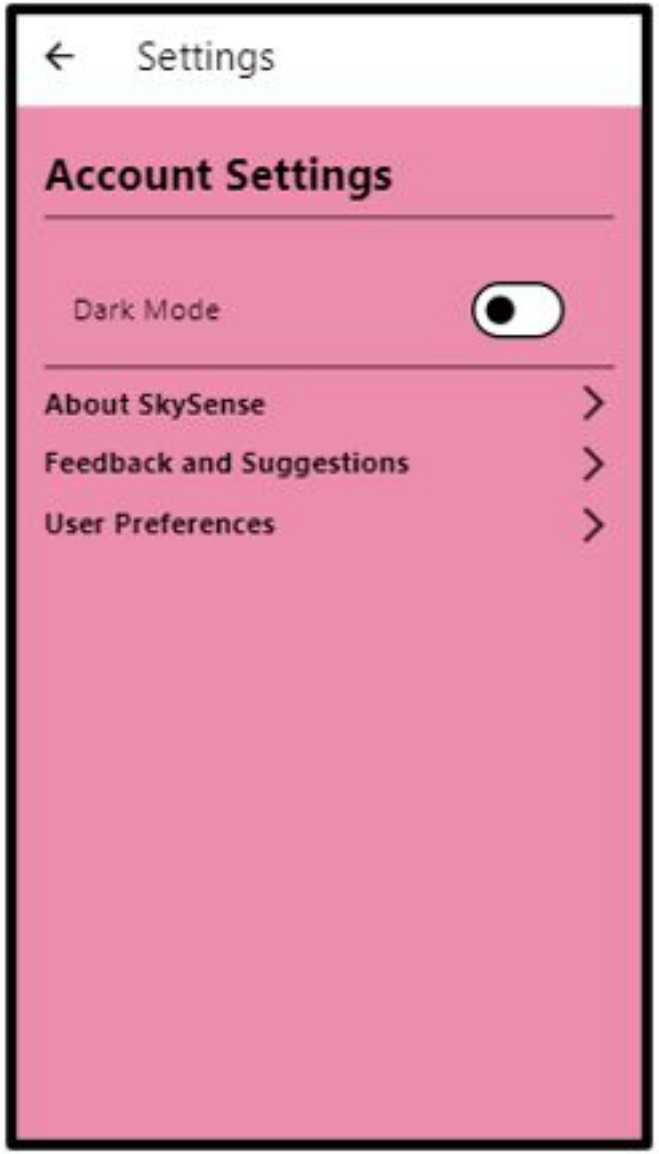
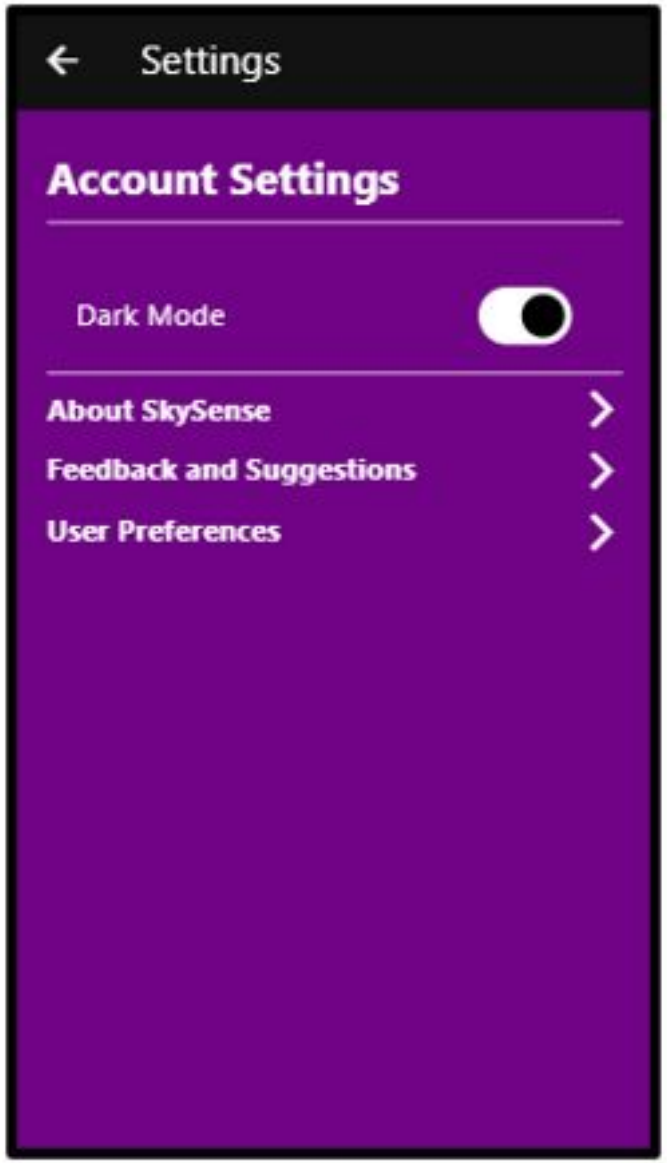
32° C
Friday
8:30 PM
30° C
Friday
11:30 PM
29° C
Saturday
2:30 AM
29° C


Settings
Account Settings
Dark Mode
About SkySense
Feedback and Suggestions
User Preferences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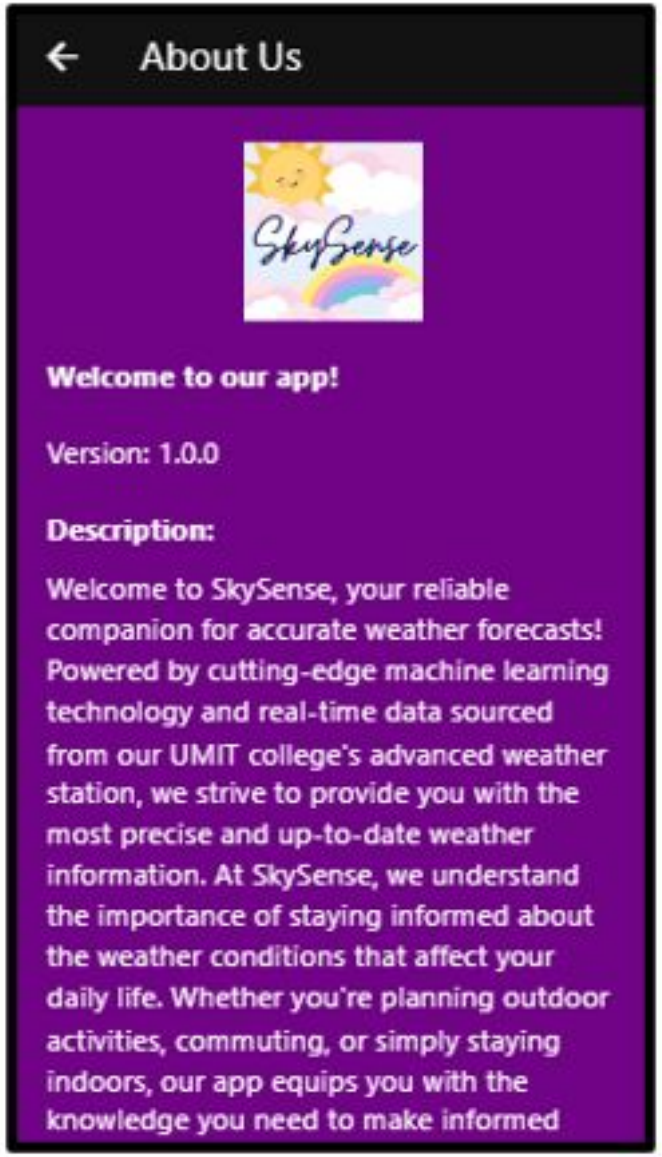
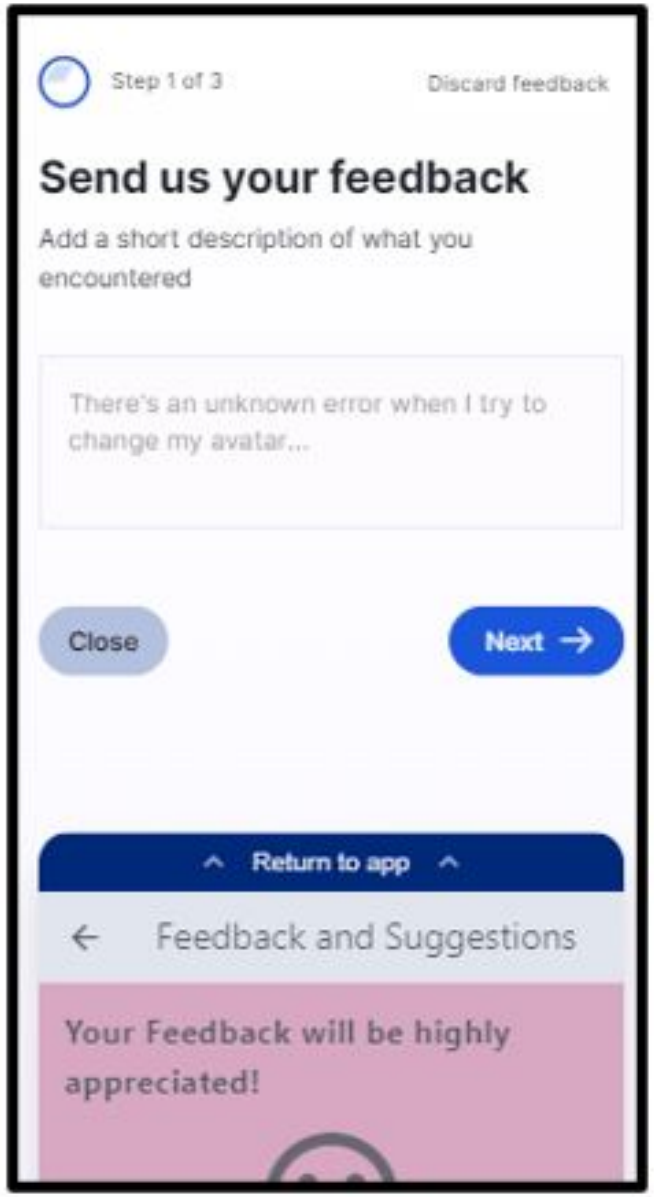

About Us
SkySense
Welcome to our app!
Version: 1.0.0
Description:
Welcome to SkySense, your reliable companion for accurate weather forecasts! Powered by cutting-edge machine learning technology and real-time data sourced from our UMIT college's advanced weather station, we strive to provide you with the most precise and up-to-date weather information. At SkySense, we understand the importance of staying informed about the weather conditions that affect your daily life. Whether you're planning outdoor activities, commuting, or simply staying indoors, our app equips you with the knowledge you need to make informed


Feedback and Suggestions
Back
Your Feedback will be highly appreciated!
Click here to Type your feedback...


Step 1 of 3
Discard feedback
Send us your feedback
Add a short description of what you encountered
There's an unknown error when I try to change my avatar...
Close
Next
Return to app
Feedback and Suggestions
Your Feedback will be highly appreciated!


User Preferences
Temperature Units
Notifications
Language
English
Data Refresh Interval (minutes)
30
Save

Future Scope

- Enhancing model accuracy with more data.
- Incorporating additional weather parameters.
- Improving user interface and user experience.
- Implementing more robust alert systems.
- Continuous feedback and model updates.
- Exploring other machine learning algorithms.

Conclusion

- Highlighted the potential improvement in predicting meteorological parameters.
- Transition from manual data collection to leveraging college weather station infrastructure.
- Demonstrated practical and efficient approach to weather forecasting.
- Showcased the integration of cutting-edge technology with user-centric design.

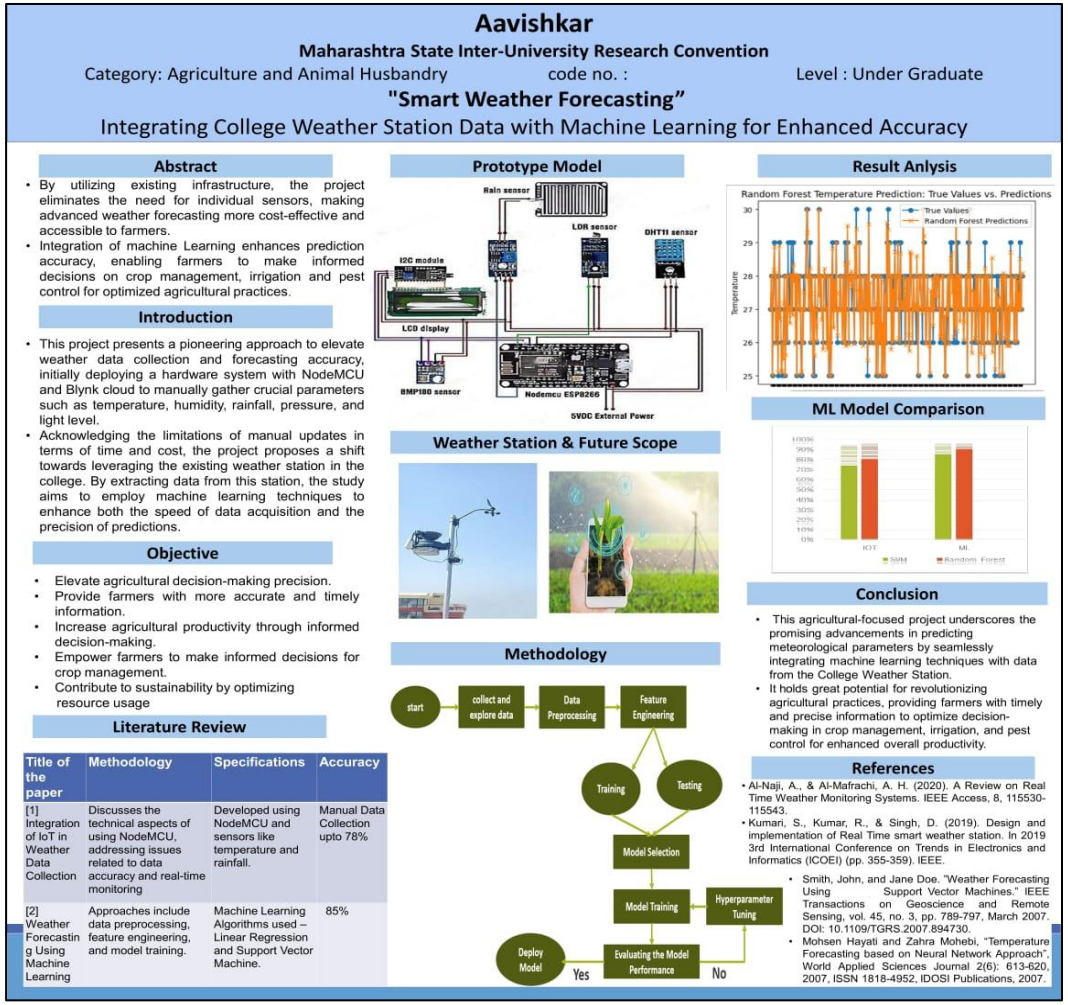
Extra Activities

Our Project Achievements:

Selected to represent our college at the 16th Maharashtra State Inter-University Research Convention "AAVISHKAR".

Recognition for innovative application of machine learning in weather forecasting in Category of Agriculture.

Got Acceptance from JoICS and IJCRT for publication.



Aavishkar

Maharashtra State Inter-University Research Convention

Category: Agriculture and Animal Husbandry code no. : Level : Under Graduate

"Smart Weather Forecasting"

Integrating College Weather Station Data with Machine Learning for Enhanced Accuracy

Abstract

- By utilizing existing infrastructure, the project eliminates the need for individual sensors, making advanced weather forecasting more cost-effective and accessible to farmers.
- Integration of machine Learning enhances prediction accuracy, enabling farmers to make informed decisions on crop management, irrigation and pest control for optimized agricultural practices.

Introduction

- This project presents a pioneering approach to elevate weather data collection and forecasting accuracy, initially deploying a hardware system with NodeMCU and Blynk cloud to manually gather crucial parameters such as temperature, humidity, rainfall, pressure, and light level.
- Acknowledging the limitations of manual updates in terms of time and cost, the project proposes a shift towards leveraging the existing weather station in the college. By extracting data from this station, the study aims to employ machine learning techniques to enhance both the speed of data acquisition and the precision of predictions.

Objective

- Elevate agricultural decision-making precision.
- Provide farmers with more accurate and timely information.
- Increase agricultural productivity through informed decision-making.
- Empower farmers to make informed decisions for crop management.
- Contribute to sustainability by optimizing resource usage

Literature Review

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Prototype Model

Weather Station & Future Scope

Methodology

Result Anlysis

ML Model Comparison

Conclusion

- This agricultural-focused project underscores the promising advancements in predicting meteorological parameters by seamlessly integrating machine learning techniques with data from the College Weather Station.
- It holds great potential for revolutionizing agricultural practices, providing farmers with timely and precise information to optimize decision-making in crop management, irrigation, and pest control for enhanced overall productivity.

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Thank You